DOCUMENT RESUME

ED 252 598 TM 850 075

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TITLE Characteristics of Mental Imagery Workspaces in Young Adults.
PUB DATE 11 Nov 84
NOTE 20p.; Paper presented at the Annual Meeting of the American International Imagery Association (8th, New York, NY, November 11, 1984).
PUB TYPE Speeches/Conference Papers (150) -- Reports - Research/Technical (143)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Cognitive Processes; Higher Education; *Individual Differences; Mathematics Instruction; Questionnaires; Sex Differences; *Visualization
IDENTIFIERS Mental Imagery

ABSTRACT

This quantitative study of imagery in 96 undergraduates addresses the problem of individual differences in the characteristics of mental imagery workspaces. A 20-item questionnaire embodying nine characteristics of mental imagery workspaces was administered to 78 females and 18 males. Analysis of variance by gender disclosed significant higher frequency of mental imagery workspaces reported by males than by females. Characteristics of imagery reported by subjects include presence or absence of mental imagery, color, black and white, movement, images of numerals, ability to control the onset and erasure of the mental imagery workspace and use of imagery to do mathematics. The main finding is that there are statistically significant differences among individuals in the characteristics of their mental imagery. This finding may be important in guiding psychotherapists to determine the capabilities and limitations of the client's imagery workspace prior to using mental imagery as a therapeutic technique. Over 10 percent of the subjects reported using mental imagery of tables or charts that had appeared in their math texts to do mathematical operations, suggesting the importance of including such visual aids in math texts, workbooks and classrooms. (Author/BS)

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ED252598

Characteristics of Mental Imagery Workspaces in Young Adults

by

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Presented at the 8th American Imagery Conference, American International Imagery Association, New York City, November 11, 1984.

RUNNING HEAD: Mental Imagery

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ABSTRACT

This is a quantitative study of imagery in 96 undergraduates, addressing the problem of individual differences in the characteristics of mental imagery workspaces. A 20-item questionnaire embodying nine characteristics of mental imagery workspaces was administered to 78 females and 18 males. Item analysis employed an SPSS computer statistical package; including 1) frequency distribution for each item and 2) analysis of variance using F tests for the variable of gender. ANOVA by gender disclosed statistically significant higher frequency of mental imagery workspaces reported within the thinking of males than by females. Characteristics of imagery reported by subjects include presence or absence of mental imagery, color, black and white, movement, images of numerals, ability to control the onset and erasure of the mental imagery workspace and use of imagery to do mathematics. Reliability analysis for the sum of all items on the questionnaire developed by the researcher produced a coefficient Alpha of .473. Main finding is that there are statistically significant differences among individuals in the characteristics of their mental imagery, in ability to control the imagery, in lack of movement in the imagery, etc. This finding may be important in guiding psychotherapists to conduct a structured interview or use a questionnaire to determine the capabilities and limitations of the client's imagery workspace prior to using mental imagery as a therapeutic technique. 71.8% of 96 subjects reported using mental imagery of tables or charts that had appeared in their math texts to do mathematical operations. This suggests the importance of the inclusion of such visual aids in math texts, workbooks and classrooms.

Early in the twentieth century, mental imagery was a major research topic, but because of the introspection involved in subjects' reports of mental imagery, research in this topic fell into disfavor among experimental psychologists. Currently mental imagery is once again a popular research topic. Sommer (1979) and Block (1981) provide highly readable histories of ideas about mental imagery and a summary of several contemporary issues on the subject. There are presently several journals and conferences devoted to research and therapy with mental imagery.

Recent research on mental imagery includes many ingeniously designed empirical studies intended to reduce the problems of inherent subjectivity. For examples of this kind of experimental research see Sheehan (1972). Such studies often include carefully specified physiological correlates of imagery, such as associated eye movements with the occurrence of mental images (Zikmond, 1972; Rey, 1981, Shepard and Chipman, 1970).

Case study reports using introspection and self-report methodology have disclosed individual differences in persons' abilities to manipulate mental images (Witz, 1975, 1979, 1980). Individuals report that they can modify their mental images at will by moving, rotating, expanding, changing shapes, sizes, angle of vision, etc., while others apparently cannot. Three percent of 96 subjects polled reported seeing no mental imagery at all.

Such individual variations in mental imagery may account for the recent hiatus in mental imagery theories between what have been called the pictorialists and the descriptionalists (Block, 1981). Pictorialists claim mental images are reifications of whatever they represent while

descriptionalists describe mental images as generated by meaning (Shepard and Chipman, 1970). It seems reasonable to assume that people may experience mental imagery in both ways pictorially and semantically, separately or simultaneously.

Piaget (1971) describes mental imagery as neural representations of sensorimotor experiences that begin about age nine months when the infant achieves object permanence, the ability to remember something when it is removed from sight. Imagery begins to function effectively representing internalized action as well as language about age two. From this Piagetian perspective mental images are intermediary between sense perceptions and symbols (e.g., numerals, words, etc.).

The study reported here is based on the assumption that most people do have mental imagery. It addresses the question whether there may be significant differences among individuals in the manner in which the mental image is experienced. It asks questions like, What percent of people have mental images that move? What percent can control-the onset, duration and erasure of their mental imagery workspace? Do females use mental imagery more than males? Are students taught about mental imagery in school? Is it common for people to use mental imagery to do math calculations? This study is the first of its kind, investigating the frequency of specific aspects of imagery within a statistically signficant sample of the young adult population.

Method

These questions (above) were developed into a twenty-item questionnaire about mental imagery using a four-point scale: agree, sort of agree, sort of disagree and disagree. Statements included in

the questionnaire are based on the assumption that mental imagery may be both pictorial and descriptive; and that images may be internalized representations of prior experiences in the sense of Piaget (1971). The present study serves as a pilot project, substantiating questionnaire items for use in a future study with a sample of several thousand subjects.

A main problem with this method is that although it is a quantitative investigation employing rigorous statistical analyses of data, the questionnaire responses involve subjects' self-reports and introspections. Penfield's work associated with neurosurgery has provided ample evidence of the location of imagery centers in the brain (Penfield and Roberts, 1959). It is assumed that subjects in this study reporting imagery do actually experience mental images.

Another problem has to do with development of questionnaire items, so these are understandable and not interpreted differently by individual subjects. For this reason analysis of the data included inspection of subjects' free responses about mental imagery.

Subjects

Subjects were 150 undergraduate students enrolled in introductory educational psychology classes. Of 96 subjects whose questionnaires were used, 78 were female and 17 male. The topic of imagery had been introduced in the classes as one of several techniques for improving recall.

Eliminated from the sample were 54 questionnaires that were incomplete. Also removed from the sample were those subjects agreeing with item 2, "I never see mental images."

Procedure

Questionnaires were administered during a regular class session. The questionnaire was evaluated in light of possible problems in content validity of specific items. Analysis of data employed an SPSS computer statistical package (Reiter, Laurine and Davidson, 1973). This included 1) frequency distribution for each item on the questionnaire and 2) analysis of variance using F tests, for the variable of gender (Glass and Stanley, 1970).

Results

The main finding is that there are statistically significant differences among individuals in their mental imagery, in ability to control the imagery, in lack of movement in the imagery, etc. These variabilities in how mental imagery is experienced among individuals are reported below as percentages of the total sample reporting on the questionnaire item related to each imagery characteristic.

Analysis of 96 questionnaires disclosed the following frequencies of mental imagery and related variables identified on the questionnaire items:

86.5% of 96 subjects were aware of mental imagery before it was introduced by the researchers or in the textbook.

5% of 96 subjects apparently do not see mental images, or are unaware of the role imagery plays in their thought processes. These questionnaires were not included in the data analysis.

98.8% of 96 subjects reported that they see mental images in color. Of those who disagreed, 4.3% indicated that they "sort of" disagreed. This suggests they may see mental images in color as well as black and white or with less frequency than black and white.

20% of 95 subjects do not see mental images in black and white. It may be assumed their images occur only in color, since subjects who see no mental imagery at all have previously been eliminated from the sample.

Of the 95 subjects responding, 82.7% are able to see mental imagery with action. Did the 16.3% of subjects disagreeing mean that they have mental images with action, but that these are not like movies, lacking a plot or characters with dialogue? Additional test items are needed to clarify this possible interpretation.

27.4% of 96 subjects do not see mental images of numerals.

62.5% who have an imagery workspace for doing math compare with 71.9% who report they can see mental images of numerals. Apparently 9.4% can see mental images of numerals but cannot or do not choose to use mental images of numerals for arithmetic operations. This item should be clarified by adding items: "I do not have a mental imagery workspace." "I do not choose to use the imagery workspace for math." And "I am unable to use the imagery workspace for math."

70.8% of the subjects have volitional control of what appears or disappears from their imagery workspace.

34.7% of sample apparently cannot control the duration or erasure of the onset of the mental image.

34.7% of subjects can see mental images, but do not choose what they are, because the images just happen. Of those who disagreed with this item, 65.7% differ by 5.1% with those indicated that they could change the mental images on their workspace if they wanted to (70.8%).

64.3% said that mental images just happen in the mind, but they can also create them if they choose to.

It is interesting, and may or may not be important, that approximately the same percent of subjects who disagreed with this item, indicating they do not have volitional control of imagery, on item 5 indicated they do not see images in both black and white and in color (8.3% of 95). Additional items could clarify this, "I see items in black and white and in color, and "I can create mental images at will." And "I see mental images in black and white and in color but I cannot make mental image come on when I want to, they just happen."

68.2% of subjects report frequent use of mental imagery to do math.

65.3% use mental images to do math problems in their heads sometimes, but not often.

Items 14 and 15 both dealt with frequency. Item 14 reads, "I often use mental images to do math problems in my head," and item 15 reads, "I use mental images to do math problems in my head sometimes, not often." How can the 23.9% difference be explained between the 65.3% of persons in item 15 and the 58.2% in item 14 who often use imagery for doing math in their heads?

53.1% of subjects indicate that there are math problems they cannot do without recourse to mental imagery.

85.7% of subjects reported that they can imagine what the mileage indicator on a car looks like when the numerals move (item 17).

Item 6 also asked subjects whether they see images that move. 16.7% said they did not and 82.7% agreed that they did see moving images (N = 95). Discrepancy between items 17 and 6 might be because certain subjects at the time of answering item 17 actually tried to see a mental image of a mileage indicator moving, but could not, even though they customarily can see moving mental images (4.2%).

28.6% reported they do not sometimes use mental images of charts or tables that they used to see in math books. This item does not include a question about the frequency of occurrence of charts and tables in subjects, math books, or elsewhere. It may be the case that some persons used math texts that did not include many charts and tables.

To item 12 (". . . do not choose, images just happen . . .") of 96 subjects, 65.7% disagreed and 34.4% agreed, compared with 53.1% disagree and 45.8% on item, 19 (". . . answers just appear"). Some portion of the discrepancy between these two items may be due to subjects in whom answers just occur, but not as mental images and subjects in whom answers occur as mental images, but only after having done the problem step by step.

Item 20 asked, "No one ever talked to me about using mental imagery to do math." 66.4% agreed. Apparently subjects who use imagery to do math have developed these techniques on their own, without instruction. Perhaps, there is need for an additional item to distinguish between learning to use imagery to do math either from teachers in school or from parents. 66.4% of subjects indicate that no one ever mentioned to them the possibility of using mental imagery to do math, yet 58% of the subjects use mental imagery to do math problems; 53% have certain math problems they cannot do without using mental imagery! Aside from questions of whether or not mental imagery may or may not be an efficacious way of performing mathematical operations, imagery apparently is a prevalent method used by education undergraduates. Educators and researchers should be seriously addressing this topic, in the classroom as well as in the research laboratory.

Reliability analysis for the sum of all items on the questionnaire (1-20) produced a coefficient Alpha of .473.

Analysis of reliability for those 9 questionnaire items related only to mental imagery associated with math (items 7, 10, 14, 15, 16, 17, 18, 19, 20) produced a reliability coefficient Alpha of .564. Means on these items varied from 21.9 to 23.0.

Analysis of variance by gender was done for items related to math, ability to control imagery, movement of imagery, a mental imagery workspace, all items 1-20 and total absence of mental imagery. Results of these F tests are presented in tables below, by gender.

A comparison of gender and the questionnaire items mentioned above provided overall evidence of "group" differences in terms of means. Of 95 subjects who completed the questionnaire, 78 were female and 17 were male.

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Insert Table 1 Here

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The only variable in which there was statistical significance for gender was that of workspace. Males reported significantly higher numbers of mental imagery workspaces than did females.

The majority of subjects have never been instructed in the use of mental imagery. Reports of people who successfully use mental imagery for math operations, recall mental images of math charts, answer tables and the like, suggest the importance of using such visual aides in schooling and in remediation. Mental imagery in math also has potential for counselors in relieving math anxiety.

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Insert Table 2 Here

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Item 1 was interpreted by the researcher to the subjects as meaning they had never heard of mental imagery before it was introduced as a topic in the course or with the questionnaire. 86.5% of 96 subjects had previously heard of mental imagery.

Items 7, 8 and 9 disclosed the frequency of mental imagery of numerals in relation to words (item 8) or story imagery (item 9). 71.5% of subjects reported seeing imagery of numerals (N = 96) and 16.3% agreed with the item "I can see mental images of words, but not numerals." This raises a question whether the remaining 53.2% are persons who use mental imagery in math, using names of numbers, rather than mental images of printed numerals? Or, do these subjects use some form of mental representation other than imagery? This might be a cumbersome way to do mathematical calculations or it might be some form more efficient than mental images.

Should schools teach young children about mental imagery? Is it a seriously negative reflection on education that 5 subjects in this study were totally unaware of the mental imagery which probably goes on within their thinking every day? Should mental imagery and its deliberate use to improve recall within various school subjects be a topic regularly taught in schools?

Is life experience less lively for persons whose mental images occur only in black and white and not in color? Could individuals who do not have colorful imagery be helped to see these in color? About 30% of people cannot control their images at will or cannot erase what

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availability of tables of math facts, either in books or on classroom walls. These might include number lines of both negative and positive numbers, square and cube roots, decimal categories and facts of addition, subtraction, multiplication, and division. This finding, that 70.5% use mental images of charts and tables, suggests it is important that the correct facts of math be available visually to students and not only in the teacher's head or answer book.

The analysis of variance for gender disclosed one variable, imagery workspace, by males, to be statistically significant. Future studies might provide a better balance in gender than this present study which used 78 females and 18 males.

Table 1
ANOVA Gender

	D.F	M^2	F	Statistical Significance
Math				not significant p = .05
Between groups	1	27.998	1.309	.2556
Within groups	93	21.395		
Control of Imagery				
Between groups	1	.010	.009	.9247
Within groups	93	1.146		not significant p = .05
Movement of Imagery				
Between groups	1	.600	.291	.5911
Within groups	93	2.066		not significant p = .05
Workspace				
Between groups	1	14.007	4.070	significant at p = .05
Within groups	94	3.441		level (.046)
Items 1-20				
Between groups	1	.311	.148	.701
Within groups	93	2.102		not significant p = .05
Never heard of imagery				
Between groups	1	.154	.209	.64
Within groups	94	.736		not significant p = .05
Don't see math images				
Between groups	1	.427	1.358	.248
Within groups	94	.315		not significant p = .05

Table 2
Relative Frequency of Response to Questionnaire Items

Questionnaire Item	% Disagree	% Sort of Disagree	% Sort of Agree	% Agree	N
1. Never heard of imagery	76.5	9.2	8.2	6.1	98
2. Never see images...	78.	15.	3.	2.	98
3. See images in color...	5.1	4.1	45.9	42.9	96
4. See images in black and white...	8.2	12.2	49.	29.6	97
5. See images in black and white and color...	9.2	1.0	27.6	61.2	97
6. See action images...	9.2	7.1	19.4	63.3	98
7. See numeral images...	9.2	17.3	28.6	42.9	97
8. Not see numeral images...	48.	35.7	10.2	6.1	98
9. With story but not math...	42.9	11.2	23.5	20.4	98
10. Imagery workspace...	22.4	15.3	32.7	29.6	98
11. Can erase imagery...	14.3	15.3	25.5	44.9	98
12. Images just happen	30.6	33.7	27.6	7.1	97
13. Images happen and can control	3.1	6.1	26.5	64.3	98
14. Images to do math	19.4	21.4	30.6	27.6	97
15. To do math sometimes	17.3	16.3	42.9	22.4	97
16. Need imagery for math	26.5	19.4	23.5	29.6	97
17. Images move	7.1	6.1	13.3	72.4	97
18. Images of charts and tables	14.3	14.3	37.8	32.7	97
19. Math answer images	32.7	19.4	28.6	17.3	97
20. No one taught me imagery	17.3	15.3	23.5	42.9	97

IMAGERY QUESTIONNARE

S. Langham-Johnson, Ph.D.

	Disagree	Sort of Disagree	Sort of Agree	Agree
1. I never heard of mental imagery before.	A	B	C	D
2. I never see mental images.	A	B	C	D
3. I see mental images in color.	A	B	C	D
4. I see mental images in black and white.	A	B	C	D
5. I can see mental images in color and in black and white.	A	B	C	D
6. I can see mental images that are scenes with action like movies.	A	B	C	D
7. I can see mental images of numerals.	A	B	C	D
8. I can see mental images of words but not numerals.	A	B	C	D
9. I can see mental images when I read a story but not when I do math.	A	B	C	D
10. In my mind I have a work space where I can write and do math problems with mental images.	A	B	C	D
11. I can "erase" my mental imagery workspace and change the images on it if I want to.	A	B	C	D
12. I can see mental images, but I do not choose what they are, because the images just happen.	A	B	C	D
13. Mental images just happen in my mind, but I can also create them if I choose to.	A	B	C	D
14. I often use mental images to do math problems in my head.	A	B	C	D

	Disagree	Sort of Disagree	Sort of Agree	Agree
15. I use mental images to do math problems in my head sometimes, not often.	A	B	C	D
16. There are certain math problems I cannot do in my head unless I use mental imagery.	A	B	C	D
17. I can imagine what the mileage indicator on a car looks like when the numerals move.	A	B	C	D
18. I sometimes use mental images of charts or tables I used to see in my math book.	A	B	C	D
19. Sometimes the answer to a math problem just appears in my head as a mental image without having done the problem.	A	B	C	D
20. No one has ever talked to me about using mental imagery to do math.	A	B	C	D

13/9

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13/9